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Humans and Animals Interact

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An independent academic psychologist, based in England, who has written extensively on different areas of psychology with an emphasis on the critical stance towards traditional ideas.

A complete listing of his writings at http://psychologywritings.synthasite.com/. See also material at https://archive.org/details/orsett-psych.

CONTENTS

1. HUMANS AND RAPID EVOLUTION

"Batesian mimicry" is where a harmless species evolves to mimic the physical appearance of a harmful species in order to avoid predation. Ni et al (2024) studied the case of the stonefly Austroperia, which is cyanide-producing and so toxic to predators, and advertises this with dark warning colouration. A mimic is the long-tailed stonefly Zelandoperia. Avian predators favour lighter coloured Zelandoperia, but only in forested areas, which Austroperia prefers as it feeds on woody debris and leaves. In deforested areas birds show no preference. Mimicry, thus, has reduced fitness in these areas (Nosil 2024).

Ni et al (2024) collected specimens of over 1200 Zelandoperia from nineteen locations (nine forested and ten deforested) in New Zealand, and scored them as mimics of Austroperia. The mean score was 0.40 in forested areas (higher mimicry) and 0.14 in deforested areas.

Human deforestation is producing rapid evolution by driving the evolution away from mimicry. "A threefold reduction in mimicry was observed in deforested sites [by Ni et al 2024], which is consistent with rapid evolution of this trait in the wild" (Nosil 2024 p377) [1].

Does this mean that the direction of such rapid evolution could be predicted? Nosil (2024) was cautious: "A challenge for predicting evolution is that there is not a one-to-one relationship between the nature of environmental change and ensuing evolutionary dynamics. A drastic and sudden environmental change may often trigger sudden evolution. However, this need not be the case if a system is resilient to perturbation, in which case change may be subtle or delayed. Likewise, even a gradual, incremental environmental change may cause a sudden evolutionary shift if it perturbs a fragile system across a threshold or 'tipping point'. By analogy, an elastic band may snap because it was abruptly cut by a pair of scissors or because it was gradually stretched beyond its capacity to remain intact. In both cases, the band is no longer intact, but the underlying causes are very different" (p377).

Prediction depends on knowing two sets of factors - external changes in the environment, and internal dynamics of the system. The former includes natural events like floods and forest fires, while the latter describes "natural" cycles of change. "A well-known

[1] The classic example of rapid evolution through the impact of humans is the peppered moth and industrial pollution in the UK (eg: Kettlewell 1973).

example of feedback is predator-prey interactions, in which reciprocal changes in predator and prey cause ongoing and predictable cycles in the numbers of each. Specifically, increases in prey allow increases in predators, which then decreases prey number and so on. An evolutionary example involves stick insects, in which ongoing evolutionary cycles in the frequency of cryptic colour-pattern morphs are driven by feedbacks between bird predation, morph frequency, and characteristics of the arthropod community. Such feedback-driven cycles lend an element of predictability to evolution, at least on modest time scales" (Nosil 2024 p377).

References

Kettlewell, B (1973) The Evolution of Melanism: The Study of a Recurring Necessity Oxford: Clarendon Press

Ni, S et al (2024) Human-driven evolution of colour in a stonefly mimic Science 386, 453-458

Nosil, P (2024) Predicting and anticipating rapid evolution Science 386, 376-377

2. ANIMAL EMOTIONS IN FOUR STUDIES

de Waal (2019) argued that non-human animals can experience the full spectrum of emotions. "That isn't to say these animals feel emotions in the same way as we do. De Waal was careful to distinguish between feelings, which are internal, subjective states and therefore unknowable to others, and emotions - bodily and mental states we can recognise through their effects on behaviour and physiology" (Wong 2023 p35).

Measurement and detection of animal emotions is a problem, however. Here are four examples of studies investigating animal emotions in different ways and in different species.

1. Enrichment experiment and mink.

Many captive animals have environments that are deprived of stimuli and novelty with negative consequences for them, so environmental enrichment is important as a means to improve their welfare. This is further emphasised when animals show a preference for novelty, as seen in two experiments with over 750 fur-farmed mink (Neovison vison) in Canada by Meagher et al (2014).

In both experiments, over a five-month period, half of the animals were placed in enriched cages and half not (non-enriched). The enriched cages included objects to play with (eg: golf balls), items to chew (eg: plastic plumbing features), and plastic pipes as tunnels. The behaviour of the animals was observed.

The animals in the enriched cages had improved welfare, overall. Juveniles showed increased play, while adults were less stressed, and had improved reproductive success (eg: offspring that survive beyond weaning).

2. Captive gorillas and cognitive enrichment.

Clark et al (2019) developed an enrichment device (the "Gorilla Game Lab" device) for captive gorillas at Bristol Zoo in the UK. It involved moving a food reward (peanut) around a series of mazes in order to get it out. The mazes could be solved by moving the nut with a finger or a stick (tool). Five out of the six gorillas used the device when given the opportunity, and the non-user was the only male in the group. Three successful gorillas used tools. There were individuals differences in the use

of the device.

There was evidence that the gorillas were interested in the device beyond the food reward, as the researchers noted with "Kera" (a 13 year-old female), who, on one occasion, "retrieved and stored 5 nuts during a bout of device use, and ate them in one batch afterward. This suggests that a food reward was of low value to Kera at the time" (Clark et al 2019 p11).

The "Gorilla Game Lab" device was classed as a form of "cognitive enrichment", which according to Clark (2011) was defined as "(1) engages evolved cognitive skills by providing opportunities to solve problems and control some aspect of the environment, and (2) is correlated to one or more validated measures of well-being" (quoted in Clark et al 2019).

3. Animal vocalisations.

Vocalisations are "indeed considered as expressions of distinctive inner states" (Coutard et al 2024 p1). Acoustic analysis of such vocalisations has an application for captive animals and their welfare.

Pig, poultry, cattle, goat, and sheep have all been studied in varying degrees with modern technology that records and classifies calls, particularly the affective states during and related to stress and pain (Coutard et al 2024).

For example, Briefer et al (2022) categorised 7414 calls from 411 pigs based on their emotional valence (positive/negative, pleasant/unpleasant), which had been collected over the lifespan. Ten acoustic parameters were used to distinguish the calls via machine learning algorithms. Two parameters were key - call duration, and amplitude modulations (or variations). Calls in positive contexts were shorter, and had fewer amplitude modulations than in negative contexts. Positive contexts included reunion after separation, huddling, and nursing (assumed to be pleasant to the pigs), and negative contexts included social isolation, fights, and physical restraint (assumed to be unpleasant to the animals). The positive-negative valence has been found in wild boars (eg: Maigrot et al 2018).

4. Operant learning experiment.

Dairy cattle are a social species, but they are often housed alone in farms. Pair housing is a

compromise, and calves show welfare benefits compared to individual housing. Buckova et al (2019) studied with a "Go/No-go task" experiment.

Sixty-six Holstein Friesian female calves housed at an experimental farm in the Czech Republic were the participants, of which 22 calves were housed individually and the remainder in pairs from twelve hours after birth. Training for the experiment involved the use of operant conditioning principles, where placing the muzzle in a particular hole led to the reward of milk after touching a "trial initiator" button. Subsequently, they learned that one location represented "Go" and another location "No-go" in order to receive a reward. Then the calves were presented with ambiguous locations that were close to the learned ones, and they could press the trial initiator. It took between 300 to 700 trials over thirty days, depending on the individual, to reach the point of the experimental test. This was "judgment bias testing", and "Go responses in ambiguous trials were interpreted as 'optimistic' responses, whereas No-go responses were interpreted as 'pessimistic' responses" (Buckova et al 2019 p4).

Ten pair-housed and ten individual-housed calves were tested with the ambiguous stimuli. The former "responded more positively to ambiguous cues than individually housed calves, indicating more positive affective states" (Buckova et al 2019 p1). Put simply, the decision of the calf to initiate a trial in response to an ambiguous location was seen as a positive mood compared to the decision not to initiate a trial. There was no difference in learning speed, however, between the two groups.

References

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Clark, F.E (2011) Great ape cognition and captive care: Can cognitive challenges enhance well-being? Applied Animal Behaviour Science 135, 1-2, 1-12

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bioacoustics to assess various components of farm animal welfare Applied Animal Behaviour Science 275, 106286

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Maigrot, A-L et al (2018) Encoding of emotional valence in wild boars (Sus scrorfa) calls Animals 8, article 85

Meagher, R.K et al (2014) Benefits of a ball and chain: Simple environmental enrichments improve welfare and reproductive success in farmed mink (Neovison vison) PLoS ONE 9, 11, e110589 (Freely available at https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0110589)

Wong, S (2023) The emotional lives of animals New Scientist 8th July, 34-37

3. NOT THE REAL WORLD

ARTIFICIAL EXPERIMENT

Invasive studies of neurons in the brain have used non-human primates in laboratory experiments in restrained contexts (RCs) (ie: head-restrained while in a primate chair). "When recording single-neuron activity, the animals are trained to perform formal motor tasks in a highly reproducible and often stereotyped manner under the general assumption that the findings can be generalised to explain how the brain controls natural actions in unconstrained contexts, but this is not necessarily the case. Furthermore, neuronal recordings during spontaneous behaviours in freely moving contexts (FMCs) have led to important discoveries in small mammals that would not have been possible under restrained contexts" (Lanzarini et al 2025 p214).

Lanzarini et al (2025) showed this in an experiment. Two monkeys were trained to move around their home cage while neural recordings were made. For the same action, differences in the firing of neurons were found between the RC and the FMC in 80% of neurons measured. The neural activity in FMCs was "richer" (ie: "greater activity and variability of individual neurons"; p214) (Lanzarini et al 2025).

SEX OF THE EXPERIMENTER

The sex of the experimenter has been accepted as a potential confounder in studies with humans, but it could also be so with non-human participants. Georgiou et al (2022) showed this with mice, who "showed aversion to the scent of male experimenters, preference for the scent of female experimenters and increased stress susceptibility when handled by male experimenters" (p1191).

The preference for human male or female scent was established by wiping the mice with scented swabs, and a three-armed maze with different scent (and a control - no scent) for each arm [2].

The researchers then showed this effect/preference at work in a study with ketamine. The same dose administered by a human male or female produced different behaviour responses in the mice. For example, decreased immobility time in the forced swim test after administration of ketamine by a male experimenter. The behaviour difference was linked to physiological changes.

[2] The scent preference has been reported previously by Sorge et al (2014).

Put simply, a biological stress reaction to male experimenters interacted with the drug. In technical terms, human male scent activated corticotropin-releasing factor neurons in the entorhinal cortex.

References

Georgiou, P et al (2022) Experimenters' sex modulates mouse behaviours and neural responses to ketamine via corticotropin releasing factor Nature Neuroscience 25, 1191-1200

Lanzarini, F et al (2025) Neuroethology of natural actions in freely moving monkeys Science 387, 214-220

Sorge, R.E et al (2014) Olfactory exposure to males, including men, causes stress and related analgesia in rodents Nature Methods 11, 6, 629-632

4. EXTINCTION OF TURTLES

Using publicly available fossil records of turtles (Testudinata), Pereira et al (2022) suggested that the "modern day" extinction threat is linked to the rise of hominins rather than specific to global climate change. This current extinction event (the third in turtle lineages) started in the Pliocene (5 - 2.5 million years ago), and one estimate is 106 known species gone extinct (Pereira et al 2022). The other two were in the Late Cretaceous period (96-94 million years ago), and at the Cretaceous-Paleogene transition (66 million years ago).

Reference

Pereira, A.G et al (2022) Two major extinction events in the evolutionary history of turtles: One caused by a meteorite, the other by hominins bioRxiv (https://www.biorxiv.org/content/10.1101/2022.07.20.500661v1)

5. WASHED HUMANS AND MOSQUITOES

Mosquitoes use volatile organic compounds (VOCs) emitted by plants and animals to help in searching for them. Human products as in soaps produce VOCs. VanderGiessen et al (2023) studied this in an experiment.

Soaps significantly alter the attractiveness of humans to mosquitoes (some soaps increasing it and others decreasing it). But, as the researchers explained, "our results suggest that rather than the isolated effect of a change in a single chemical's concentration (either absolute or relative), the modulation of mosquitoes' host-seeking behaviour is the result of the interplay between changes in the concentration of soap chemicals and the specific composition of the individual host's scent. Supporting this point, the fact that the well-known mosquito repellent limonene is one of the most abundant chemical compounds in all the soaps we tested but, remarkably, did not elicit aversion in three of the four soaps we tested" (VanderGiessen et al 2023 p6).

Human skin emanations (ie: by-products of metabolic activity and skin microbiota) are an "odour print". This odour profile is also a product of genetic differences, gender, age, food consumed, exercise, and health status, for instance (VanderGiessen et al 2023).

VanderGiessen et al (2023) controlled for individual differences in odour by offering the mosquito a choice of the same person - eg: the left arm washed with a particular soap and the right arm unwashed.

Four brands of soap was used - "Dial", "Dove", "Native" and "Simple Truth", and the yellow fever mosquito (Aedes aegypti) was the test species, and five human volunteers. Sleeves with or without human odours and soap were presented in dual-choice free flight trials. Landing on one sleeve was classed as a choice.

Reference

VanderGiessen, M et al (2023) Soap application alters mosquito-host interactions iScience 26, 106667

6. LANDSCAPE OF FEAR FOR ELKS

The Yellowstone National Park had a problem in the later 20th century of elks overrunning it because of few predators. In 1995 wolves were reintroduced officially to create a "landscape of fear", "scaring elk away from their favourite dining spots of aspen stands and willow thickets. Elk ate worse diets, had fewer offspring — and trees, rivers, grasses, even songbirds returned, in a glorious example of a revitalised ecosystem" (Morell 2024 p366).

But Hobbs et al's (2024) analysis of data for 1999 to 2019 suggested that elk numbers dropped not from fear of wolves, rather "a guild of predators [grizzly and black bears, cougars, and wolves], including human hunters, which killed enough elk to let vegetation partly recover..." (Morell 2024 p366). Between 1995 and 2011 humans killed ten times more elk than wolves (Morell 2024).

This study, however, only focused on 113 plots of aspen stands in northern Yellowstone (Morell 2024).

References

Hobbs, N.T et al (2024) Does restoring apex predators to food webs restore ecosystems? Large carnivores in Yellowstone as a model system Ecological Monographs 94, 2, e1598

Morell, V (2024) "Landscape of fear" had little impact on Yellowstone ecology Science 386, p366

7. HUMAN IMPACT ON SPECIES RANGE

Humans have altered species ranges. "Range contraction and expansion varies across species due to human impact... However, the ultimate 'winners' of the Anthropocene are introduced species, which expand into new geographic regions through human-driven dispersal and establishment... While in contrast, the 'losers' are the extinct and threatened species that have experienced severe native range contraction due to human impacts like overharvesting, pollution, climate change, and land-use change" (Jesse et al 2024 p2). This has been described as the "two sides of the same coin hypothesis" or "introduced-extinct opposite ends hypothesis" (Jesse et al 2024).

The idea is that introduced and extinct species are at different ends of the same continuum on traits (eg: body size; fecundity; longevity; genetic diversity). "After introduction, species with suitable functional traits tend to be more successful in utilising novel food sources and enduring local climatic regimes... In contrast, extinction-prone species generally are ecological specialists, characterised by narrow dietary and climatic niches and poor dispersal abilities due to their geographic restriction to mountain tops, islands, or isolated nature reserves in a matrix of anthropogenic land use" (Jesse et al 2024 p2).

Though there are differences between introduced and extinct species, there is not strong evidence for the opposite-ends idea in studies of plants, mammals, and birds, for example (Jesse et al 2024).

Jesse et al (2024) built a database of over 3000 reptiles (snakes and lizards) in the Western Hemisphere (the Americas) to study the opposite-ends idea. About 150 species had been introduced elsewhere and just under 500 were extinction-prone (ie: from "vulnerable" to "endangered" to "extinct"). Support was found for the opposite-ends hypothesis. "Introduced species had larger, edgier ranges, while extinction-prone species had smaller, simpler ranges [range insularity]. Introduced species were mostly herbivorous/omnivorous, while extinction-prone species were mostly carnivorous. Introduced species produced larger clutches, while extinction-prone species had smaller body sizes" (Jesse et al 2024 p1).

Reference

Jesse, W.A.M et al (2024) Elevated human impacts on islands increases the introduction and extinction status of native insular reptiles Ecogeography 2024, 11, e06817

8. PETRELS AND PLASTIC POLLUTION

Plastic pollution is a threat to marine life, particularly oceanic birds. "Many seabird species are sensitive to plastic pollution; they frequently ingest plastic, which can have lethal and sub-lethal impacts caused by chemical contamination and physical damage or blockages. Numerous factors affect the amount of plastic accumulated by different species including foraging behaviour, at-sea distribution and gut morphology. Among seabirds, albatrosses and petrels can contain particularly high loads of plastic ingested directly or within their prey" (Clark et al 2023 p1).

Clark et al (2023) concentrated on petrels (of which there are 123 species) as they are "particularly sensitive because they retain plastic for long periods due to their gut morphology" (p1). These researchers assessed risk from marine plastic exposure for 77 species using tracking data between 1995 and 2020. Data on over 7000 adults from 148 populations in 27 countries were collected. Each species was given a plastic exposure risk score (ranging from 0.003 to 549, with a theoretical score of 15.3 if mean plastic density was evenly distributed throughout the world) based on the area where the birds lived, moved, and fed, and the number of plastic pieces estimated in that area.

The highest scores were given to species in five areas - the Mediterranean/Black Sea, and northeast Pacific coastal regions, and ocean gyres in northeast and northwest Pacific, south Atlantic, and southwest Indian oceans. The lowest scores were for species in the Humboldt and Canary currents, and polar regions.

Overall, the European storm-petrel had the highest risk in the Mediterranean (with a plastic exposure risk score of over 300).

There were seasonal differences in scores for some species depending on their migration sites. For example, the Scopoli shearwater breeds on Malta in the Mediterranean (high risk) and migrates to the eastern Atlantic ocean (lower plastic exposure risk).

Reference

Clark, B.L et al (2023) Global assessment of marine plastic exposure risk for oceanic birds Nature Communications 14, article 3665

9. LYNX AND WILDFIRES

Climate change impacts animals directly through temperature and precipitation pattern changes, and indirectly through events like wildfires. The Canada lynx (Lynx canadensis) (figure 9.1) in Washington State, USA, is particularly impacted.

"Lynx were listed as a threatened species under the United States Endangered Species Act (ESA) in 2000... and the conservation status changed from threatened to endangered in Washington in 2017 because of habitat loss to large wildfires, small residual population size, contracted range within the state, and continued vulnerability to the ongoing threat of wildfires" (Lyons et al 2023 p2).

(Source: Edwin and Peggy Bauer, US Fish and Wildlife Service; public domain)

Figure 9.1 - Canada lynx.

Lyons et al (2023) used twenty years of telemetry data to analyse the impact of wildfires on the lynx population in the North Cascades Ecosystem in Washington State [3]. Three years were sampled for comparison - 2000 (low wildfire burning), 2013 (17% of lynx habitat burned), and 2020 (another 15% of habitat burned). Overall, there was a 66-73% reduction in lynx carrying capacity in the study area between 2000 and 2020. "Carrying capacity" refers to the maximum population size

[3] This area has seen changes in temperature (around +4 °C) and precipitation (around -45%) in July and August between 1980 and 2020 (Lyons et al 2023).

of a species that an area/ecosystem can sustain. For example, the loss of forest directly impacts animals that eat vegetation, which could be the prey of the lynx. So the loss of forest indirectly threatens the survival of the lynx population.

"Threats to lynx from climate change also include loss of deep, soft snowpack... that affords lynx a competitive advantage over bobcats and other carnivores that prey on snowshoe hares... Another threat to the lynx and its most important prey species, the snowshoe hare, is also posed by a recent outbreak of rabbit haemorrhagic disease (virus 2) in domestic rabbits and feral domesticated rabbits in Washington and British Columbia" (Lyons et al 2023 p17).

Reference

Lyons, A.L et al (2023) Climate change, wildfire, and past forest management challenge conservation of Canada lynx in Washington, USA Journal of Wildlife Management 87, 5, e22410

10. HUMAN-CATTLE INTERACTIONS

"Animal-assisted interaction" (AAI) describes the therapeutic benefits of spending time with animals, most often pets. Fine et al (2013 quoted in Compitus and Bierbower 2024) defined AAI more formally as a "goal-oriented and structured intervention that intentionally includes or incorporates animals in health, education, and human services (eg: social work) for the purpose of therapeutic gains in humans".

This is distinct from "animal-assisted activity" (AAA), a "planned and goal-oriented informal interaction and visitation conducted by the human-animal team for motivational, educational and recreational purposes" (Fine et al 2013 quoted in Compitus and Bierbower 2024), and "animal-assisted therapy" (AAT). Humans benefit from these activities, but what about the animals? Compitus and Bierbower (2024) focused on cattle. Colloquially, "cow cuddling" or "cow hugging" describes time with cattle by individuals who do not live and work usually with them (Compitus and Bierbower 2024).

A study was undertaken at a micro-farm sanctuary in New York State, USA, with rescued animals (2 steers), and eleven humans. The "Human-Animal Interaction Scale" (HAIS) (Fournier et al 2016) was the measure used. It has two parts - part one is the human's perception of the interaction with the "therapy animal", and part two covers the perception of the animal's behaviour.

The human participants reported the interactions as positive in the main. While "the steers showed a strong preference for interactions with women when compared to men and, in turn, the women reported stronger attachment behaviours toward the steers. It is unclear without further testing whether the animals sought out the attention of women in general or if the women were more likely to initiate the actions when compared to the men participants" (Compitus and Bierbower 2024 p7).

References

Compitus, K & Bierbower, S.M (2024) Cow cuddling: Cognitive considerations in bovine-assisted therapy Human-Animal Interactions 12, article 1

Fournier, A.K et al (2016) The human-animal interaction scale: Development and evaluation Anthrozoos 29, 3, 455-467

11. LOCOMOTOR SYNCHRONISATION WITH DOGS

"Dogs exhibit remarkable sensitivity to humans' body positions, gestures, head and hand directions... as well as to humans' attentional states" (Lamontagne et al 2024 p1).

But familiarity with the human is important. "Notably, they are more attentive to their owner than to other individuals..., and they spend more time with their owner than with an unfamiliar person in an unfamiliar environment... Interestingly, this effect of familiarity is context-dependent, as pet dogs allocate more time to the unfamiliar person in a familiar setting... Moreover, in non-play interactions with an unfamiliar person, pet dogs spend less time looking at the person and more time avoiding the latter compared to non-play interactions with their owner... Finally, pet dogs exhibit more soothing and contact-seeking behaviours when they are petted by a familiar person than by an unfamiliar person" (Lamontagne et al 2024 p1).

Dogs form a social preference in concurrent choice tasks with two unfamiliar persons, each behaving differently (eg: Duranton et al 2019). "These studies showed that dogs established a social preference for one of the two people within 15 minutes. Moreover, their preference for the one person was similar in magnitude to the pet dogs' preference for their owner. Specifically, the amount of time spent by the dogs near the preferred person was not significantly different from the amount of time spent by pet dogs near their owner in a similar setting" (Lamontagne et al 2024 p2).

Duranton et al (2019) noted the importance of human behaviour synchronisation in influencing a dog's social preference. "Behavioural synchronisation is a form of spontaneous behavioural alignment, ubiquitous in many social species, and defined by three components: it occurs when two or more individuals exhibit the same behavioural patterns (activity synchronisation) in the same space (location synchronisation) and within fewer than 3 seconds (temporal synchronisation)" (Lamontagne et al 2024 p2). Duranton et al (2019) found that unfamiliar persons who synchronised their locomotor behaviour to that of the dog were preferred by the dog more than unsynchronised unfamiliar persons (Lamontagne et al 2024).

Lamontagne et al (2024) developed this work in their two-part experiment. Thirty-two dogs were the participants (based on their owners in France volunteering for the study). In phase 1, the dogs were

randomly allocated to one of two groups. In an outdoor open space, "for the synchronisation with dog locomotion (Sync) group, the experimenter synchronised their locomotion with that of the dog for 15 minutes: they stayed close to the dog and adjusted their speed to that of the dog; for the desynchronisation with dog locomotion (Desync) group, the experimenter desynchronised their locomotion with that of the dog for 15 minutes: they stayed away from the dog and did not adjust their speed to that of the dog" (Lamontagne et al 2024 p3). The experimenter did not interact with the dogs in any other way.

In phase 2, the experimenter walked away from the dog in a straight line at one of two speeds (or was static) for fifteen seconds each. This was a repeated design in that all three speeds were randomly used with each day, whereas phase 1 was an independent design. The dog's locomotor synchronisation with the experimenter was measured in phase 2.

The dogs in the Sync group in phase 1 were more likely to synchronise with the experimenter in phase 2. Location and activity, but not temporal synchronisation were found.

The researchers explained: "We thus demonstrated that dogs, upon perceiving behavioural synchronisation from an unfamiliar person, reciprocate with behavioural synchronisation towards this person, thereby elucidating for the first time motor contagion at the interspecific level. Also, since dogs usually synchronise their behaviour only with familiar humans, our findings suggest that synchronising with dogs, by maintaining a proximity of 1 m and an average speed difference of 0.2 m/s, is a way of becoming familiar with them. We thus offer a valuable tool, applicable in various daily situations in which the owner is present, to facilitate familiarisation between dogs and unfamiliar people, without the need for food or direct contact with dogs" (p1).

The study had a "recruitment bias" in that the experimenters "selected dogs comfortable with unfamiliar people to study to avoid inducing stress in the participating dogs" (Lamontagne et al 2024 p11). Furthermore, "since recruitment was based on voluntary participation, through posters in dog parks and on social media, the owners who participated were inherently interested in their dog's behaviour and more broadly in dog-human interaction. This type of dog-owner relationship may have an influence on the dogs' behaviour and their reaction to an unfamiliar person. Moreover, the presence of the owner in our study likely impacted the

dogs' behaviour. Previous studies have demonstrated that dogs behave differently when their owner is absent, often displaying more passive behaviour and waiting towards the exit where their owner left" (Lamontagne et al 2024 p11).

References

Duranton, C et al (2019) When walking in an outside area, shelter dogs (Canis familiaris) synchronise activity with their caregivers but do not remain as close to them as do pet dogs Journal of Comparative Psychology 133, 3, 397-405

Lamontagne, A et al (2024) Walk with me? Part 1: Dogs synchronise with an unfamiliar person who first synchronised with them Applied Animal Behaviour Science 272, 106204

12. CANINE BIO-DETECTION

Odours emitted by the body are chemical signals that have evolved to communicate to other members of the species. But inter-specific communication is possible, as in dogs detecting odours of humans.

Wilson et al (2022) investigated the dog's ability to detect stressed humans. The "canine bio-detection paradigm" has been used to detect various human health conditions in previous research (appendix 12A). In these studies, "a 'scent-wheel' or 'line-up' is used, where the dog is exposed to several human biological samples and trained, through positive reinforcement, to indicate the target odour by performing an alert behaviour on the sample that is indicative of that health condition. The dog is then tasked with discriminating between target samples and other samples taken from controls such as healthy individuals or individuals who have a similar health condition. It should be noted that this paradigm does not allow insight into a dog's untrained response to an odour; however, it does offer a level of control that is desirable when attempting to address the question of whether a physiological process confers a detectable odour. Most large-scale human disease studies use a 'generalisation paradigm' whereby dogs are taught their target odour by being shown many samples taken from people who have the same health condition. Over repeated exposure, the aim is that dogs learn to recognise commonality associated with the condition across the samples and can ignore individual differences unrelated to the condition (eg: age, sex, diet, medications)" (Wilson et al 2022 pp3-4). Other methods used to detect both human and non-human odours include memory for odours, odour threshold tests, and ability to "match-to-sample" (Wilson et al 2022).

The assumption behind all methods is that "human body cells release volatile organic compounds (VOCs) that are exhaled in the breath, emanated from the skin, found in urine, and faeces and saliva. Different VOC profiles can be signatures of physiological changes" (Wilson et al 2022 p4). Studies have found different VOCs in the sweat, for example, of stressed and non-stressed individuals (eg: de Groot et al 2020).

Wilson et al (2022) used samples of combined breath (exhaling into vial three times) and sweat (taken from back of neck) taken from the same 36 humans at baseline (no-stress) and during an experimentally induced state of stress (eg: mental arithmetic under time pressure) (a

"controlled olfactory paradigm"). The four dogs used were trained to show an alert response when presented with a stress sample and two blanks (no sweat or breath) in Phase 1 (ten training trials). Phase 2 (testing) involved discrimination between the same individual's stress and no-stress samples, and a blank (figure 12.1). The combined accuracy of the dogs was 93.75% over 720 trials. This was statistically significantly more than expected by chance.

(Source: Wilson et al 2022 figure 3)

Figure 12.1 - Photographs of the apparatus and dogs using it.

Key methodological issues with this study included:

i) Small sample of dogs, but this is typical of bio-detection studies "due to the time-consuming nature of training highly specialised dogs" (Wilson et al 2022 p19).

ii) The within-participant (or repeated) design controlled for many variables - ie: the same participant provided a no-stress and stress sample in a trial. "Each participant acted as their own control, minimising potential issues of variance from background VOCs associated with age, sex, ethnicity, diet and lifestyle" (Wilson et al 2022 p20).

iii) The stress-inducing task failed to produce stress for eleven participants. There are ethical issues with an experimental task that is too stressful. The ideal would be samples from real-life stressful situations.

iv) Unintentional (non-olfactory) cues to aid the dogs. The researchers accepted: "It is possible that, over time, the dog learns to integrate extraneous cues, relating to either the samples or the apparatus" (Wilson et al 2022 p20).

APPENDIX 12A - HUMAN DISEASE DETECTION

"Dogs can be trained to detect target odours with a sensitivity that surpasses the capabilities of not only humans, but most modern instruments" (Holt and Johnston 2024 p2). Can this be applied to the case of Parkinson's Disease (PD)?

A proof-of-concept study (Gao and Wang 2022) showed that three Belgian Malinois-breed dogs could detect PD.

Holt and Johnston (2024) reported a larger study which used various breeds of dogs, and handler-blinded controls. Twenty-three dogs were trained, and then tested with t-shirts worn overnight by 43 PD-positive and 31 PD-negative adults. Overall, the dogs averaged around 90% accuracy in correct olfactory distinction between positive and negative cases. Technically, the dogs were scored for sensitivity (correct identification of PD-positive cases) and specificity (correct identification of PD-negative cases) (table 12.1).

The study showed that "companion dogs can detect a Parkinson's-associated target odour, which likely exists

as one or more volatile organic compound(s)" (Holt and Johnston 2024 p18).

The data came from a project in the USA called "Parkinson's Alert Dogs" begun in 2016. The aim is to use olfactory cues of PD for early diagnosis before physical symptoms appear. "By the time a patient receives a clinical diagnosis, the disease has progressed to the point of a 60% dopaminergic reduction in the basal ganglia of the brain. Due to this reduction in dopamine, the diagnostic hallmark symptom of tremors become present, along with other associated symptoms, such as loss of balance, cramped handwriting, sleep disturbance, and altered patterns of speech... The gradual reduction of dopamine is estimated to begin in the brain 5–10 years before the presentation of the symptoms that lead to a clinical diagnosis" (Holt and Johnston 2024 p1).

		DOG'S RESPONSE	
		PD-POSITIVE	PD-NEGATIVE
TRUE SITUATION	PD-POSITIVE	Correct - True Positive (Sensitivity)	Incorrect - False Negative (ie: dog missed true case)
	PD-NEGATIVE	Incorrect - False Positive (ie: healthy individual that dog classed as PD)	Correct - True Negative (Specificity)

Table 12.1 - The possible outcomes for the dogs.

References

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